

ABSTRACT

01/329217

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3 *24* Systematic use of infrared image analysis in conjunction with currently used visible image analysis  
4 techniques provides significant improvements in automated analysis of tool marks. In particular, the  
5 method and apparatus of this patent identify illumination-induced artifacts such as glint and shadow, detect  
6 features such as additional striations hidden by shadows, and correct for apparent reversal of lands and  
7 grooves due to the angle of illumination used to obtain the visible images. By using the infrared images to  
8 detect and eliminate artifacts and make local corrections to features in the visible images, the resulting  
9 matching of visible tool mark images against a database of similar images produces more accurate  
10 matching with a greater number of located matches. Since current databases of tool marks, including  
11 ballistic signatures, contain visible images only, the use of infrared analysis may be initially limited to pre-  
12 processing new images compared with and added to the databases.

13 As infrared camera prices are reduced, it is predicted that the IR analysis methods of this patent will  
14 become the standard matching technique, due to their significant advantages. Infrared analysis of tool  
15 marks provides classification, alignment, characterization, comparison, matching and identification of such  
16 marks with better specificity and repeatability than analysis in the visible spectrum. In the case of ballistics  
17 item matching, the proposed method and apparatus can automatically extract and characterize the marks  
18 associated with a particular manufacturing process or caused by a particular weapon including: striations,  
19 firing pin indentation, breech, extractor and ejector marks, resulting in more accurate automated matching  
20 against databases of bullets, casings, and weapons.

21 The method can be enhanced by active infrared imaging which includes heating or cooling the item  
22 under examination to enhance markings which have different depths of surface features or which are  
23 caused by differing emissivities due to surface abrasion or due to differing materials. The method can also  
24 be enhanced by imaging using a range of spectral filters. This provides compositional analysis of the  
25 material of the ballistic item and the nature of any identified debris on the item.